Seeing Technology Through Five Phases: A theoretical framing to articulate holism, ethics and critique in, and for, technological literacy

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Abstract
This article presents a tentative framing that has emerged out of one person's theorised and reflective professional practice with pre-service primary and secondary Design and Technology teachers as well as with practising teachers, school leadership teams and curriculum policy designers and writers. Over many years, several curricular and pedagogical challenges have presented themselves and, in part, the framing is an attempt to address such challenges. However, the framing principally engages with the major challenge of helping 'make the invisible visible'. That is, given the pervasiveness and complexity of the phenomenon of Technology (big 'T'), is there a way of helping 'see' it more easily? It is hoped that this theoretical framing might be a valid contribution the development of ethical technological literacy. Critical commentary is sought.

Key words
technological literacy, design and technology teacher, education, curriculum, ethics, holism, critique

Introduction

This article presents a tentative framing that has emerged out of one person's theorised and reflective professional practice with pre-service primary and secondary Design and Technology teachers as well as with practising teachers, school leadership teams and curriculum policy designers and writers. It does not report conclusive data but is more the outcome of one practitioner's striving to find a solution to an educative problem concerning an aspect of technology's complexity. It reports personal 'latest thinking' that has emerged from: conversations; questions; debates; pedagogical challenges; attempts to articulate and advocate Design and Technology to those not familiar with the field; accessing associated literature; and, plain old classroom trial and error over a period of more than a decade.

The challenges that have arisen have been both curricular and pedagogical. While there may be nothing remarkable about nominating certain points or phases in a technology's development, what is presented here seems to have been successfully addressing several issues simultaneously. It is hoped that the article can contribute usefully to Design and Technology's ongoing curriculum conversations. It explains the context of the emergence of the framing, describes the influences that shaped it, and elaborates on the nomenclature adopted. The framing and its phases are then presented.

'Seeing' technology/ies

…the essence of technology is by no means anything technological. Thus we shall never experience our relationship to the essence of technology so long as we merely represent and pursue the technological, put up with it, or evade it. Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we like to pay homage, makes us utterly blind to the essence of technology. (Heidegger, 1953 trans 1977:4)

It can be problematic to draw from Heidegger at any time – not least because of the density of his work or because of his relationship with National Socialism in Germany. As Ihde (2006a:270) puts it '…if one does philosophy of technology, Heidegger's dark shadow is unavoidable…While most of the best-known European philosophers began to deal with technology between the World Wars…it was Heidegger whose work soon overshadowed all the others.'

This said, the extract from the opening pages of Heidegger's 'The Question Concerning Technology' reflects what is, for me, a critical educational conundrum. That is: *given that technologies are one of the defining characteristics of our species and that they are intricate, if not intimate, to our everyday personal existences, why is it that we do not have an education to match and address the phenomenon in its complexity?*

Heidegger explores the 'essence' of technology in relation to human existence and shows that if we want to 'see' technology for what it really is then we need to look in ways that are not technological. (The issue of the 'essence of technology' has subsequently travelled much further – see e.g. Feenberg, 1999; Ihde, 2006a.) Since we live through, and by, technologies all the time it is not easy to conceive alternative 'ways of seeing'. And what is the case for society and the world at large is just so for education too. It is what has been described as the 'within-it/without-it' problem for curriculum (Keirl, 2007). That is, how can

we get *apart from* that which we are *a part of* in order to see it, critique it, and educate for and about it? Technologies are in many ways invisible to us. I mean by this that they cannot be seen in their totality and that, usually, we have no *need* to see them beyond their immediate practical value to us. We may not be interested in their other attributes, or, we may not want to be bothered by them. When we first encounter a technology it is in the foreground of our perceptions, learning and lives. In time it drops into the background (a term that returns below). For example, to say that 'we go to work' is tight shorthand for a plethora of technological arrangements and encounters. In our everyday lives we have no need of further analysis or detail. Such phrases embody, and veil, technological complexity.

The search for an appropriate technological literacy for democratic global citizenship calls for ways to help young people improve their capacities for 'seeing' designs and technologies for what they are, and can be, in this world. This article sets out a theoretical framework which has been conceived to be of help in achieving such an educational aim. In doing so, it addresses several issues and audiences connected with the field of Design and Technology Education.

Influences shaping the framing

There have been several issues or paths that have lead to this proposal and they have arisen from both theoretical and practical needs. In trying to articulate what I have called 'ethical technological literacy' (Keirl, 2006a) several theoretical issues present themselves as challenges. In particular, those applicable here are ethics itself, holism, and critique, and a few comments on each is necessary.

Ethics

There have been concerns articulated for at least two decades about the place of 'values' in Design and Technology Education (Layton, 1992; Keirl, 2000; Keirl, 2006b; Norman, 2006) and the case for ethics – in several ways – needs to be put too. First, there is the curriculum ethics of just what should constitute technological literacy given that the term can be constructed anywhere along a spectrum from instrumental to critical-emancipatory (after Habermas, 1971). Second there is the ethics of technologies themselves – in the sense of their conception and their impacts. Third, and slightly different from this last point, there is the ethics of the designer of technologies, for example, the choices of the values that are 'designed into' the technologies. Fourth, and linked with these two is an ethics of production.

In short, there are ethical questions to be asked around all stages of a technology's development. An education for a rich technological literacy needs to be able to break down technologies' complexities in some way to make visible the ethical and values issues.

Holism

The reductionist or instrumentalist case for technology education is one that maintains the subject in a tight curriculum box with only a few 'special' relationships with other (particular) 'subjects'. (Subject becomes an apt term here if the sense of subjection is allowed.) Such a curriculum construction mitigates understandings of the complex nature of technologies as they interplay with lives and worlds. To understand *Technology* (upper case 'T'-with-italics representing the meta-phenomenon of'technology') demands holistic approaches that incorporate context, values, interpretations, culture, identity, power attributes, and more. Educationally, this calls for a holistic approach to technological literacy, one such being Seemann's (2003) articulation of technacy.

Critique

It is now generally accepted, after a couple of decades of deepening philosophy of Technology, that all technologies are problematic, their manifestations are complex and that they are arguably political. Thus, it can be argued that the penetration and absorbtion (the implied dynamics here are intended) of technology in our lives and worlds is to such a depth of completeness that the phenomenon engages multiple branches of philosophical, political, sociological and psychological engagement (see e.g. Winner, 1977; Bijker et al., 1989; Green & Guinery, 1994; Feenberg, 1999; Dusek, 2006).

Such a variety of approaches and richness of intellectual study illustrates the importance of critical thinking and discourses about *Technology*. Meanwhile, in educational circles from primary to tertiary, critiquing is a disposition equally invaluable both to designing and to the interrogation of the values and merits of extant technologies, products and systems. The nurturing of a critiquing disposition serves specialist Design and Technology Education and generalist education for democratic life (Keirl, 2001; 2004) equally well.

Supporting professionals' thinking and practice

In parallel, over the years, there have been practical needs of professionals to be met. Whilst I might call the three issues named above 'theoretical', there can be no value in such theory if it does not serve professional practice.

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In Design and Technology teacher education it is important that student teachers understand their role in contributing to the technological literacy of all school students whether through general education or in specialised ways for those pursuing Design and Technology in depth. I do not believe that the subject called Design and Technology can be held responsible for the totality of a rich technological literacy education in schools so two matters arise here.

First, Design and Technology teachers themselves need to understand the context in which they are working and their particular role. To do this they need to be well educated in their curriculum and policy knowledge as well as in their pedagogical practices. This way they can contextualise learning for their students and they are also equipped to 'fight their corner' against competing curriculum interests (Barlex, 2007). Thus, secondly, a school's management team and policies need to be clear about what is meant by technological literacy and what role every member of staff can play in its articulation.

In turn, this leads to another significant group who are potentially shapers, makers and breakers of curriculum for technological literacy. Time and again, those within the field come up against those beyond (colleagues, principals, parents and, significantly, policymakers) who continue to draw on the tired stereotypes about Design and Technology – that it is really (or should be): ICTs; making things; vocational education; or, linked with science and mathematics in preference to other significant fields of human and educational enterprise such as the arts or social sciences.

It can seem that there are many, within and beyond the field of Design and Technology Education, who either fail to understand the significance and subtlety of the 'invisible' technologies issue or, often as a result of this, take a 'so what' attitude of indifference, or even refusal, to try to understand. One consequence, intentional or otherwise, is a reductionist one that keeps Design and Technology contained, marginalised and disempowered – such is the politics of curriculum. Another consequence is that, without a quality Design and Technology education for societies at large, a culture of technological blindness or complacency can pervade.

The challenge that arises with regard to these various audiences (pre-service and in-service teachers, managers, policy writers and makers, the community) is itself an educational one to show, first, that *Technology's* complexity cannot simply be expressed in reductionist terms and, second, that the complexity is manageable and can (drawing from Bruner, [1960]) actually be taught in intellectually honest forms across the years of schooling. Central to meeting this educational challenge are our teachers and those who educate them. Thus, the role of this tentative framing is to offer a way through the complexity that is respectful of educational agendas as well as of global ethics.

'Framing' and 'phases' – notes on terminology

The 'making *Technology* visible' challenge cannot be answered by simply breaking a whole into its parts – that would be a rather technological approach – precisely Heidegger's point. Anyway, practitioners in our field are well aware that, while any analysis of the progressive emergence and development of a single technology may have distinctive stages to it, there are invariably (depending on terminology) overlaps and interplays rather than crisp delineations. Further, what is being explored here is clearly more than mimicking some kind of elaborated design process. Therefore the selection of terms to articulate the thinking around the issues discussed above should be clarified.

The term *phase* has been settled on not only to give identity to one phenomenon or circumstance but also to signify a role as a co-dependent within a whole (the holism challenge above). Further, in the wave sense, *phase* is suggestive of both having varying characteristics within itself and of representing a dynamic. The Shorter Oxford Dictionary definition is apt here: 'Phase: any one aspect of a thing of varying appearances; a state or stage of change or development.' (Trumble & Stevenson, 2002). Thus materiality, multifacetedness and change are embraced – all valid attributes of *Technology*.

So far as the use of *framing* is concerned, what is sought is a sense of a structure on which something is worked – but which subsequently becomes redundant - rather than something that is enclosing or permanent. The matter is problematic because, as Green says, 'Pinning down the concept of framing, and of technology, is like trying to nail jelly. As the action begins to bite, everything moves.' (Green, 1994:xxix). Because of this, the term as described suits the purpose. The fact is that *Technology* under scrutiny is ever-fluent, it is 'polypotent' (Sclove, 1995) and/or 'multistable' (Ihde, 2002), even 'autonomous' (Ellul, 1964; Winner, 1977).

Despite these justifications, and noting Heidegger, the irony is not lost that *phase*, *framing* and their respective applications are being used technologically as tools for this article! The 'within-it/without-it' issue remains.

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Another term which warrants expansion is that of *background*. The term has philosophical roots which are both hypothetical and obscure (Kögler, 1995) so I wish to stress that, for the purposes of this article, these roots have not been explored and a more everyday description of the intended meaning has been constructed. *Background* is used here in an attempt to capture and acknowledge *that which is with us* at any time in our lives *but is also beyond* our immediate attention, interest or use. While it is the background against which our lives are set, we are also part of it and, through our being, we contribute to it. The background is basically anything and everything that already exists. It embraces nature and all human-made technologies and it provides context for our feelings, thoughts, actions and lives. This is not to over-develop a word with a commonly understood meaning. Rather, it is to establish the richness of the term and its significance for the locating of the framing and the phases and thus assist in 'seeing' technologies.

The phases

Figure One offers an intentionally basic representation of the framing. The diagram shows the sequence of the phases: *Intention, Design, Realisation, Use, Consequences* which should not be seen as discrete identities but, rather, as co-dependent. Clearly, they have a temporal order but, given the iterations of technological development, this may not universally apply to all technologies. The phases are not arbitrary and their respective rationales are presented below. All the phases arise from, and happen against, the *background*. However, it is the consequences phase which maintains the space-between a technology's use and its receding into the background. The diagram attempts to show *consequences* spreading expansively from the *use* phase whilst also becoming a part of the much greater pool that constitutes the background.

The intention phase

It is well established that design is an intentional activity. It is not about accident. It is distinguishable '…from serendipity or discovery by chance…' as Archer (1992:9) puts it. However, the proposal here is that the act of *intention* be distinctly identified and separated from what follows in the sequence, that is, design and subsequent phases. In fact, the intention phase is arguably the one phase which can be conceived of apart from others. Intention is seen here as something in the mind of an individual or in the discussions of several people but it is couched in a context of understanding that acknowledges *consequences* – desirable and undesirable - in many senses eg moral, cultural, environmental, social etc. If there is an intention to act (e.g. design and make) then

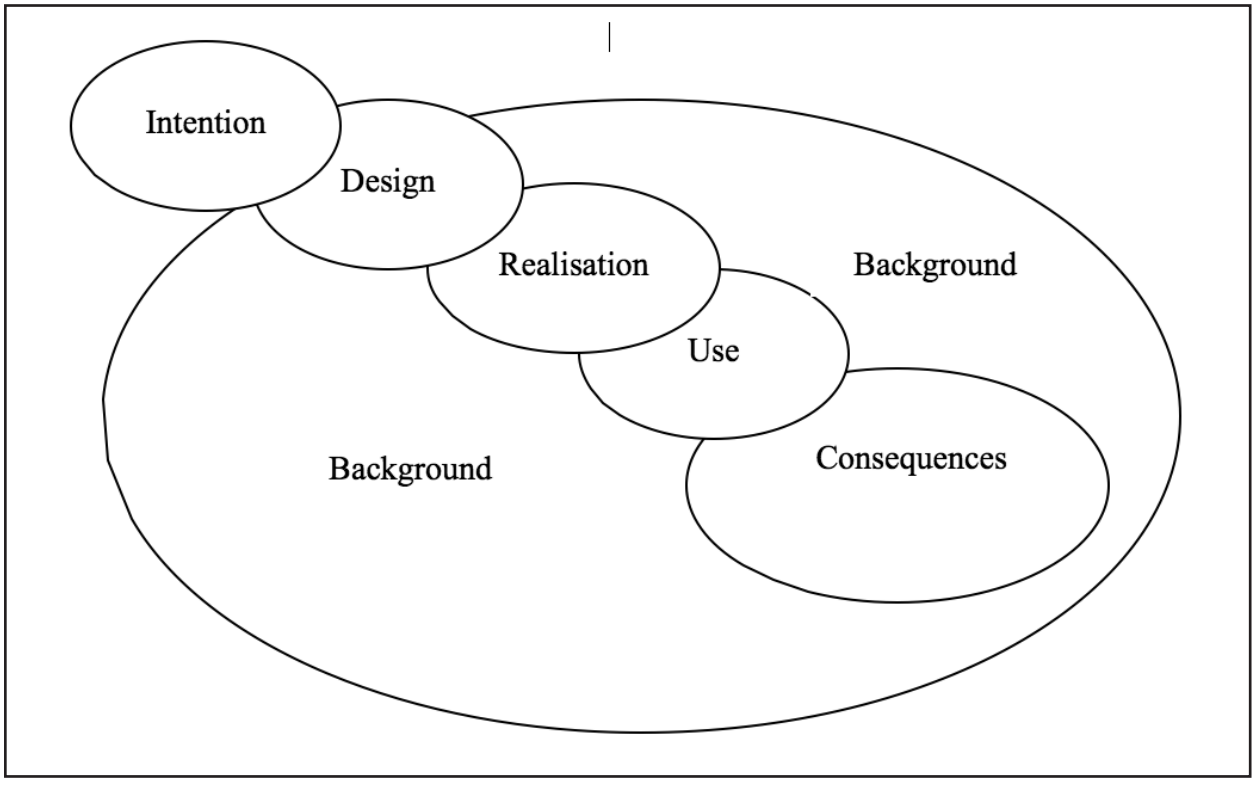

Figure 1. The framing – five phases and the background

there are associated responsibilities to consider before proceeding.

This point is well illustrated when one is conducting ethical or values interrogations of a technology. Often, hindsight is the great prompt for ethical questioning. The technology is enacted and then we see and learn what happens. Sometimes, knowledge of potential hazards or downsides is suppressed. Serious ethical interrogation at the intention stage may not only influence the nature of a design but may even conclude that a design not proceed at all. This position is not a claim that we can predict every consequence of this or that technology but, rather, it is to highlight the importance of interrogative action at the outset.

There are aspects of milieu that arise from the background. That is, the intention to design or the belief that a need has been identified, happen as a result of social, cultural and political circumstances. Thus, even a consciousness of the background's influences on one's thinking is necessary. For example, as rampant consumerism and obsolescence comes under increasing scrutiny, so the need to design for 'the market' (capitalism's preferred pseudonym as Galbraith [2004] points out) may itself be questioned. In another setting, genuine human need or environmental challenges may offer the milieu for design solutions of a particular type (Nielsen, 2006; Steffen, 2008).

An argument from Sclove (1995) serves to illustrate the issue of milieu:

Technologies do not just appear or happen; they are contingent social products…The process by which one set of designs rather than another comes to fruition is influenced by prevailing social structures and forces, including the preexisting technological order. However, this process also reflects explicit or tacit social choices, including political negotiations and struggles. (Sclove, 1995:19)

What has been said so far largely relates to the potential of the intention phase to assist understandings of technological ethics and values. However, there are other dimensions to consider. Implicitly, the term intention can be engaged with matters of will, so the field of determinism arises. Determinist arguments refute that we have any great say in the shaping of events and that '…all our choices, decisions, intentions, other mental events, and our actions are no more than effects of other equally necessitated events.' (Weatherford, 1995:194). This position, of course, fits with the idea of background as shaper (the *cause* of our design and technological *effects*) but this alone could not constitute conclusive support for the determinist argument.

First, to return to ethics, Warnock (1998) points out that the determinist argument is anathema to ethical theory. As she argues, ethics implies choice which is illusory for determinists. Elsewhere, Winner (1977) cautions that determinism is a '…potential swamp of intellectual muddles.' (Winner, 1977:74). More recently Ihde (2006b) has drawn on literary theory of early last century which developed the term 'intentional fallacy' and he has offered the concept of the 'designer fallacy' to our thinking around intention and design. 'In simple form, the "designer fallacy", as I shall call it, is the notion that a designer can design into a technology, its purposes and uses.' (Ihde, 2006b:121). Thus, any confidence that the outcomes of our intentions and designs can be guaranteed must be treated warily.

Within such debates is where the intention phase should take place. Put otherwise, I argue that if an intention phase is to be valid and to bear scrutiny, it must articulate itself in the light of ethics, determinism and any pretensions to guaranteeing outcomes. To this end, the intention phase may consider matters of volition – which can be described as the exercising of the will or acting after deliberation. That is, the act of moving on to *actually* designing (the next phase) is premised on (hopefully) reasoned deliberation of all the possible consequences imaginable if the design, realisation and use phases were to be pursued.

The *intention* phase is still theoretical and tentative. However, full recognition of the will-to-act is rich. First is the recognition that we have a will (not a totally uncontentious point). Second is a decision-making process of whether to act or not – the exercise of the will. Third, if the decision is to act, comes the action itself which, in the case of this framing, is that of design. The concept of volition is articulated for different purposes but in considerable depth by Mitcham (1994) who cites it as one of his 'modes of the manifestation of technology.'

The design phase

For the purposes of this article, no elaborate discussion of the design and realisation phases is presented. This is not to underplay their significance whatsoever but, rather, is to recognise the knowledge and interest bases of the readership. It is assumed that practices such as designing and making/creating/realising/producing are not only familiar but are also understood for their relationships, at least in educational settings, with each other. Nor is this to say that, for design, there are not contestations about meanings or methodologies. It is precisely because of these that design/ing has so much to offer 21st Century education. There are many design processes or ways of designing and these will have varying strengths of rapport with the intention phase (if any) and a production phase

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(recognising that not all design need result in production). Furthermore, it must always be remembered that many thoughts, decisions and actions occurring at this phase can do so without full recognition of the unconscious, implicit and stereotypical values that are at play.

Reflecting the focus of this article, the design phase offers much educational engagement with ethics and critiquing. The judgements that are continuously demanded when designing are ones that embrace values, ethical choices and critique. A part of a student's rich design education illuminates the values discourses and debates that are implicit in design practice. Critiquing is a powerful personal and social tool and its practice can be well developed in design decision-making and technological analysis (Keirl, 2004).

The realisation phase

A term was sought for this phase that stepped away from many of the common namings for a stage that is about the bringing-into-being or production, that is, post-design (acknowledging the iterative nature of the design-production relationship). So far as it can be distinguished from adjacent phases, this phase is about those activities that take place following a technology's design and before its release for use. This phase is about bringing the technology to a real form.

Words such as 'making' and 'production' with their craft and industrial applications fall short of the richness required here and they have less application where technologies such as digital, genetic and nano- are concerned. Meanwhile 'creating' (with a spectrum of understandings including the psychological and the religious) has implications reaching well beyond the meaning intended for this phase. 'Reification' offered potential in its sense of materialisation, of turning a design into into an object or thing but a strict understanding would concern *thinking* of a thing materially as in conceptualising in the mind's eye (Ferguson, 1992). Its meaning dwells a lot on thing-ness and materiality and this, again, detracts from the less visible-tangible technologies.

The settlement, tentatively, has been on *'realisation'* which offers the senses of 'making real' and 'becoming real' and can be applied to any technology from a legal system to the curiously named virtual technologies which are, of course, quite real in themselves. But there is another sense of realisation that describes 'becoming conscious of', 'an awareness' or 'dawning' and this is appropriate as it acknowledges the reciprocal of the non-neutral stance of technologies, namely, that they themselves cannot *be* without some reciprocation with the human designer/maker/user.

In the sense that realisation is 'making-material' or 'bringing-into-being' it only becomes so when the technology enters a personal or public consciousness. That is its dawning as well as ours. It is acknowledged here that there may be plenty of technologies that are not part of our private or collective consciousnesses but this does not detract from the fact that someone, or an organisation, *is* aware of the technology's existence. This matter is one of the very issues of 'seeing' technologies that this framing seeks to address. Ethics and critique can, again, be engaged significantly with both senses of the realisation phase.

The use phase

This phase addresses the opening up of technologies to the world (and the world to them). There is a temptation to think that this fourth phase would suffice as a final phase after those of intention, design and realisation. But such an embracing phase would become particularly problematical as much happens once a technology is 'out there' (see *consequences*, below).

The naming considerations for this phase also entertained several possibilities. One was *application* which embraces its own richness, for example, the 'bringing into contact with' sense and that of 'bringing to bear' as well as that of 'use' itself. Consideration was also given to *existence* which, while most appropriate in terms of existential philosophy and technology, would have deepened matters too much. *Presence* carried similar risks. There was also plausibility in that which might address the duration of a technology's *life cycle* – thus the phases might have been conception, incubation, birth, life, death – continuing the historical trend of attributing the 'natural' to technologies, or even, humanising them. But this approach, too, is problematic, not least because of the after-life of technologies – which can in fact be quite pervasive in both duration and effect.

The term *use* emerges as appropriate in all of its common senses in reflecting both engagement with, and of, a technology as well as practical action. Also, for the purposes of this framing and, in particular, this phase, the term *use* offers some valuable bounding. It allows some setting-apart from the subsequent phase. Although the plural 'uses' was considered it was deemed superfluous as *use* can imply singular or collective use. Besides, when viewing the take-up of technologies, two categories of *use* suggest themselves. First, there is the use that is directly reflective of the purposes or intentions of the designer(s)

– intended use. Second, there is/are use(s) that were not those intended by the designer(s) – non-intended use(s) (which may be considered as creative, or as misuse, or even as abuse). I have chosen not to apply the terms 'primary' and 'secondary' for these categories as this could imply a sense of ordering and/or a particular relationship to each other.

It is also felt that, for many people, these two categories are reasonably accessible. Further, it is argued that the bounding of the use phase offers opportunities for observation, discussion, analysis and research *as distinct from* the far more subtle and complex matters of consequences (below) which can also come under scrutiny. In pursuit of the goal of accessing 'the invisible', the *use* of technologies is a phenomenon readily familiar in public, educational and academic circles.

The consequences phase

Having given something of a boundary to the *use* phase it is possible to envisage a fifth phase (the term 'final' is eschewed) which embraces *all* the consequences of a technology's being. *Consequences* (the plural is intended and necessary) has been chosen in order to represent in two senses the (possibly many) phenomena resultant from a technology. First any consequence can be linked back to the other phases and, potentially, can be seen in the present, and projected into the future. This is the temporal sense of *con*-sequence and it must be understood that there can be no timeframe to this phase. Consequences may be brief or may last millennia (the alphabet and radioactive waste come to mind). Second, there are many *kinds* of consequences to be disclosed (below) and these will present themselves differently – from being very real parts of everyday life to being only accessible through scrutiny of the background.

With regard to alternative namings, similar remarks could perhaps be made of the *impacts* or *effects* of technologies. However, both have a reductionist shade to their meanings. The former has a ballistic sense and a tendency toward the direct and the immediate rather than the subtle. Meanwhile, the latter too readily echoes determinism's 'potential swamp' begging, implicitly, 'causes'. *Consequences* is intended here to incorporate for this phase fluidity, multiplicity and complexity.

Consequences may be patently clear, subtle or invisible (at least to the uneducated eye) possibly having receded to the background. To illustrate this an example can be taken of the mobile phone. (Its many uses, intended and non-intended, are not the focus here so only a selection are identified.) To today's generation of children in a large part of Western/minority world countries, the mobile phone is a daily phenomenon – it is 'normal', a part of their milieu – even while the name 'mobile phone' is becoming redundant. It is thirty-five years since the first iterations of this phone appeared and twenty-five years since the 'brick' began to be replaced (Thompson, 2005). In the early 1990s the mobile became more commonly available and but still met with a mix of derision, social comment, and research. Today, critics of the adoption of these phones are, as happens with techno-decliners, derided as 'Luddites' while the phone has become variously a necessity, a tool of the trade, a personal organiser, a fashion accessory or a status symbol.

The device (in fact, many variants thereof) has reshaped communications and social networking, has been valued both positively and negatively in multi-varied situations at work and play. It has opened new communications possibilities for locations and communities previously not connected to phone networks. It has brought new types of inter-personal, national and international surveillance. It has created a major environmental issue with regard to obsolescence. Radiation concerns remain for users and communities, the latter also taking network towers into their environs. Accidents resulting from phone use while driving have invoked new laws. The use and availability of the phones in public places has brought new opportunities and contention. 'Texting' has brought a new word, a new skill, new cultures and headaches for educators.

Much readily accessible literature can be drawn into such an analysis. For example: Eisen's (1999) 'suppressed inventions'; Ihde's (2002) multistability and 'designer fallacy' (2006b); Mitcham's (1994) 'four manifestations'; Nixon's (1996) 'function creep'; Schumacher's (1986) 'Small is Beautiful'; Sclove's (1995) 'polypotency'. 'elite Luddism' and his 'temperamental elephant'; Tenner's (1997) 'unintended consequences'; Winner's (1977) 'reverse adaptation'; and so on. If evidence were ever needed as to the non-neutrality of technologies it is surely to be found in the *consequences* phase. This is where Heidegger might be searching for the essence of technology in helping us understand existence and our human 'being'.

The discussion regarding the mobile phone is just a brief sketch of *some* of one technology's consequences. Similar critiques of ethical, psychological, social, philosophical, cultural, semiotic, design, environmental, health, anthropological, legal, political, financial, linguistic, historical, etc consequences are applicable to *any*

technology. There is nothing special about this newer technology. Hammers would warrant similar scrutiny. Through all these fields of human endeavour, technologies' (*and Technology's*) consequences are currently being researched and theorised.

Conclusion

There is a vast literature available for the academic study of the technological phenomenon and its consequences. This, to me, is rather ironic because, on the one hand, there is so much interest, theorising, and literature that it could be said that the massive human enterprise called *Technology* is plain for all to see – it must be visible because of the intense scrutiny. On the other hand, the problem, it seems, is that the bulk of this scrutiny has still to be engaged by education – my conundrum mentioned above.

Technology is pervasive. It helps define our species. It shapes us and we would claim to shape it yet the phenomenon of *Technology* has generally been taken for granted by us for a long time – certainly since the Enlightenment. As has been shown, multiple fields of the academy offer their own lenses and analyses on the phenomenon. Meanwhile, we are in a time of rapidly converging digital, nano and genetic technologies. Furthermore, issues around democracy (itself a designed technology, I would argue) are several. First, there is little democratic engagement in the design and development of technologies. Second, many technologies threaten to undermine democratic life and the concept of citizenry (for example, surveillance, dataveillance, identity design/manipulation/theft). Third, because of these circumstances, an education is needed to develop a politically healthy and active citizenry. Such an education amounts to a particular kind of ethical technological literacy and Design and Technology Education has a significant role to offer in this project. The challenge is to manage the enormity of the *Technology* phenomenon in meaningful ways for all involved with the development of a democratic citizenry and democracy itself.

This article makes a tentative case for a *framing* which can facilitate an overview of *Technology*-against-the-*background* as well as offering particular views of the phases of any one technology's development. Put a different way and (after Heidegger) *the framing is perhaps a way of seeing the whole of a technology by looking at its phases using non-technological ways of seeing.* In total, these ways of seeing/viewing amount to a *discourse of holism*.

To achieve the democratics of practice needed to *know* life (in all forms and global sites) with *Technology* at least two other discourses are enabled through the framing – the ethical, addressing a spectrum from values-weighing to big questions like 'How should we live?; and, critiquing – of one's own and others' design decision-making and technological products, processes and systems. Students with well-developed ethical and critiquing dispositions will be well placed to play a role in democratic life.

To talk of a significant role for Design and Technology Education is to recognise the advances the field itself has made over recent decades. It is also to recognise the field's strong position *within* the *framing*. Whilst the totality of the phenomenon *Technology* is a matter for the whole-school and whole-system curriculum, Design and Technology can readily promote its leadership credentials in curriculum re-design. It is the field with deep experience of, and a growing research record around, many of the pedagogical and curriculum issues.

What has been offered here has grown out of theorised and reflective practice with a spectrum of players (students, teachers, policy-makers, school leaders) across the Design and Technology field over an extensive period of time. Whilst at one level the *framing* is designed to support all such players in their understanding, learning and advocacy, at another level it is presented fully cognisant of the as-yet unresolved educational and philosophical challenge of *making the invisible visible*. For these reasons, the *framing* and the *phases* remain tentative and critical commentary is sought. Nevertheless, the overall goal remains – that of finding ways to help establish an ethical technological literacy that serves democratic global citizenship.

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